MAPLE WORKSHEET for GRAPHS OF POLAR EQUATIONS (Section 12.7)

Math 142 -- Spring 1994

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This worksheet illustrates the graphs of 'simple' polar equations. These curves can be classified into four major categories:
lines, cicles, cardioids and limacons, and roses.

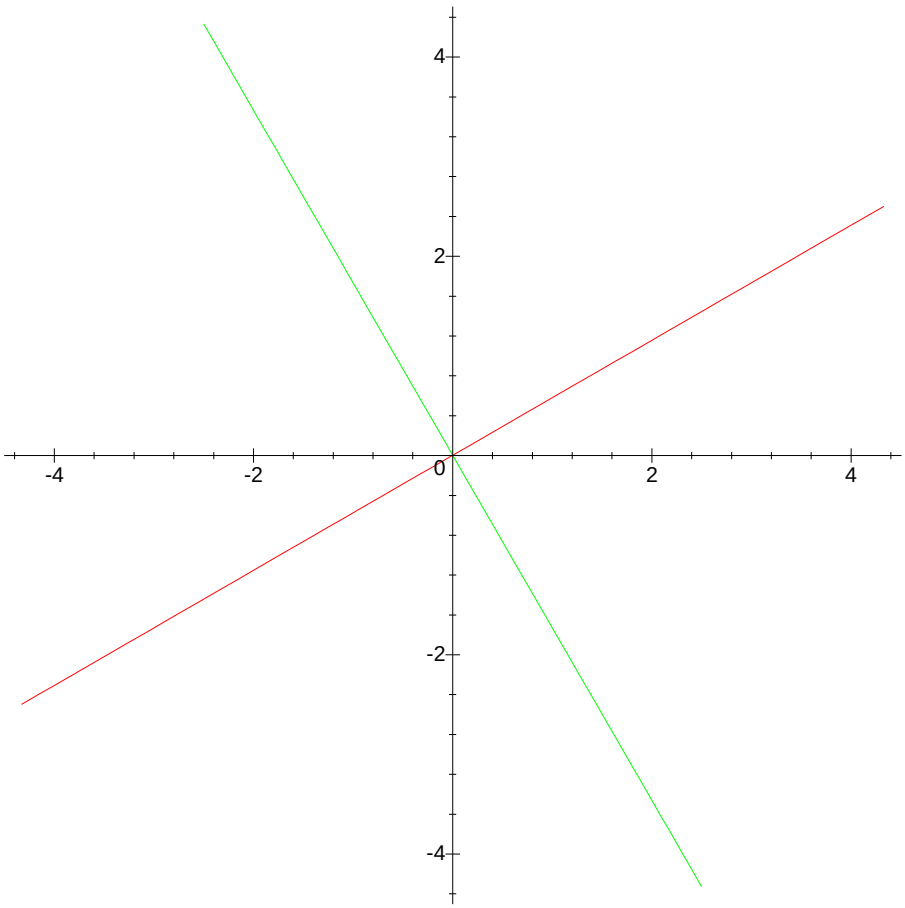
```
> restart;
> with(plots):
> setoptions(scaling=constrained):
```

## *LINES*

Lines through the ORIGIN are given by theta=constant. Lines which do not include the origin are much more difficult to represent.

Here are the lines with angles Pi/6 and 2*Pi/3...

```
> polarplot( {[r,Pi/6, r=-5..5], [r,2*Pi/3,r=-5..5]} );
```



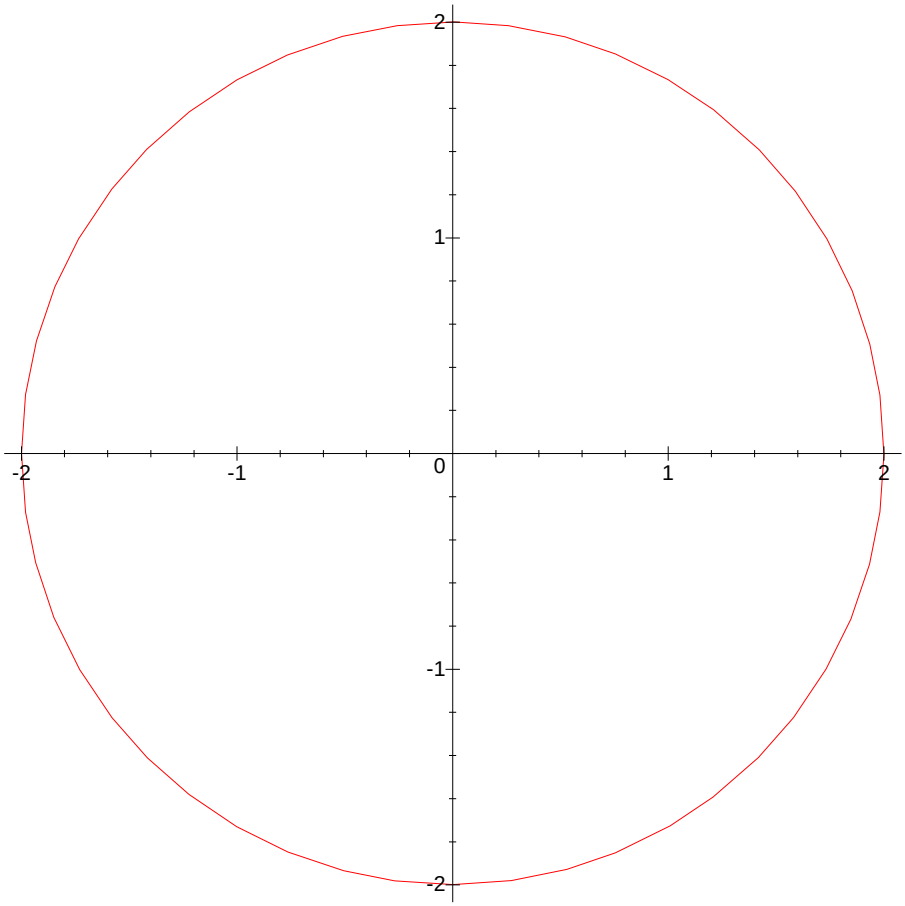

## *CIRCLES*

There are several different forms for circles, depending on where the center is located.

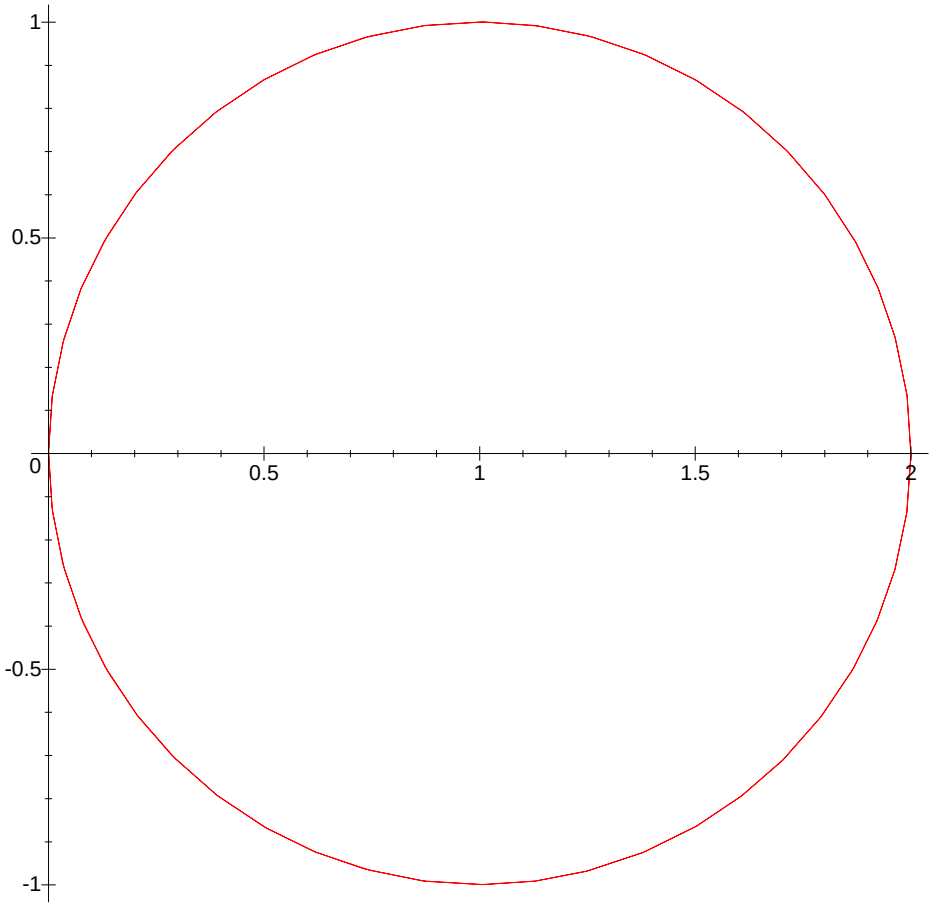
$r = a$ Center: (0,0); Radius: a
$r = 2\,a\cos(\theta)$ Center: (a,0); Radius: a
$r = 2\,a\sin(\theta)$ Center: (0,a); Radius: a

Here are the graphs of one of each type

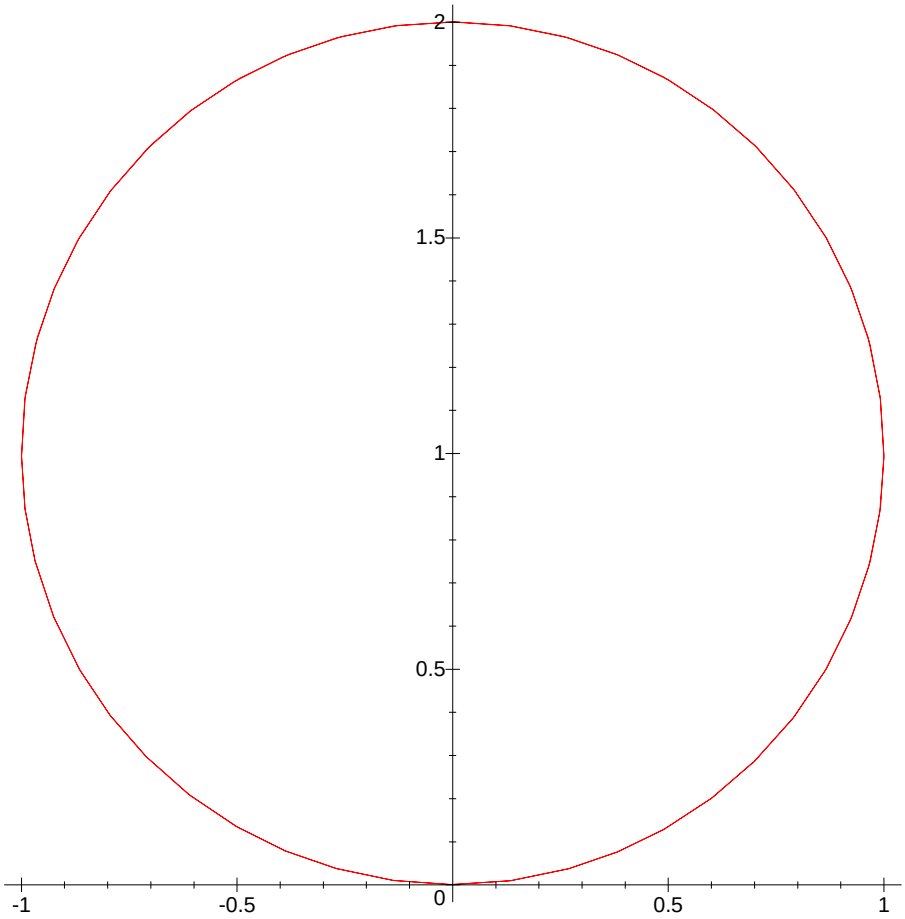
```
> polarplot( 2 );
```




```
> polarplot( 2*cos(theta) );
```




```
> polarplot( 2*sin(theta) );
```




## *CARDIODS and LIMACONS*

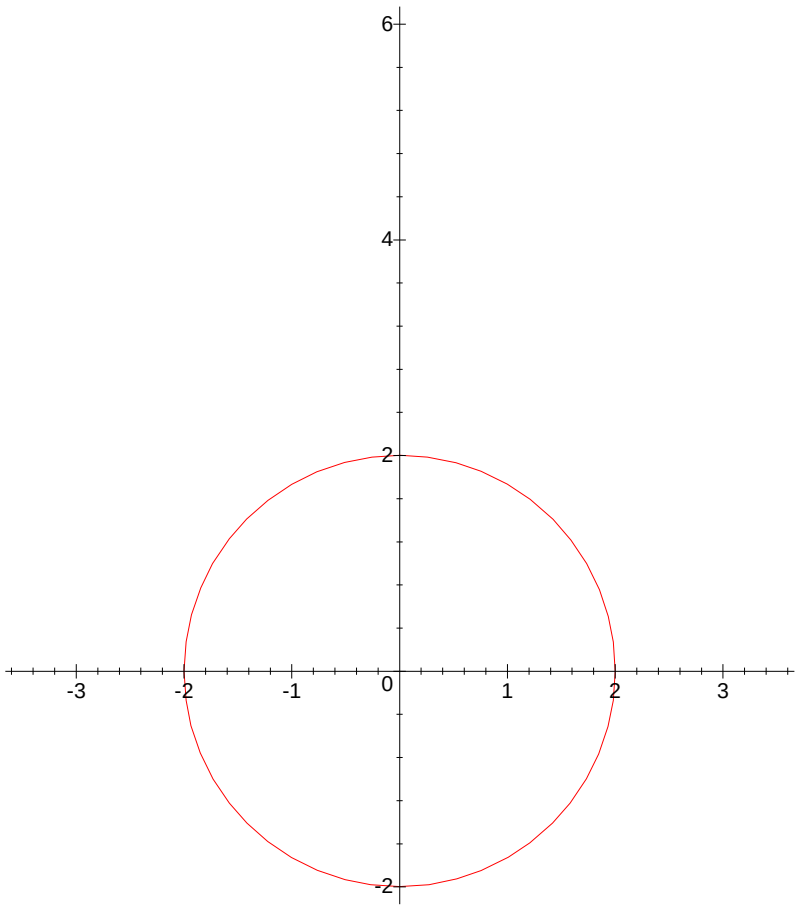
These names are very descriptive (particularly if you know a little French).

Cardioids sounds as though they should have something to do with the hear; they do!
Limacon is French for snail. This seems like a strange description, let's see how this name fits.

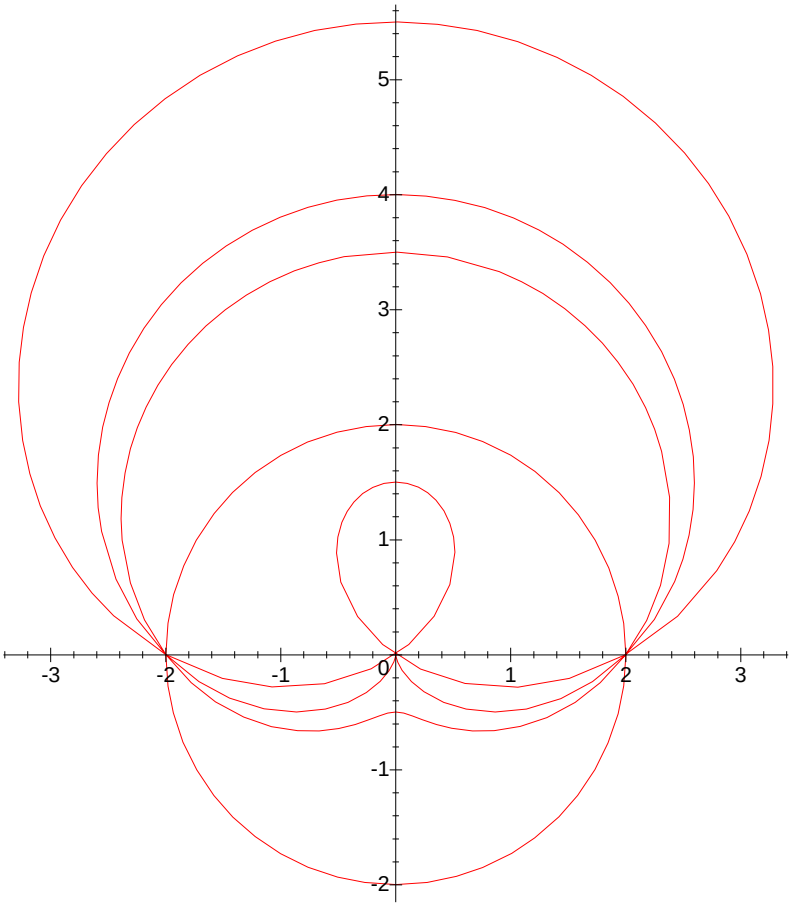
General form: $r = a + b\cos(\theta)$ and $r = a + b\sin(\theta)$

The relative sizes of *a* and *b* determine the type of the graph.

```
> C1 := [seq( polarplot( 2+‘i‘/2*sin(theta) ), ‘i‘=0..8 )]:
> display( C1, insequence=true );
```

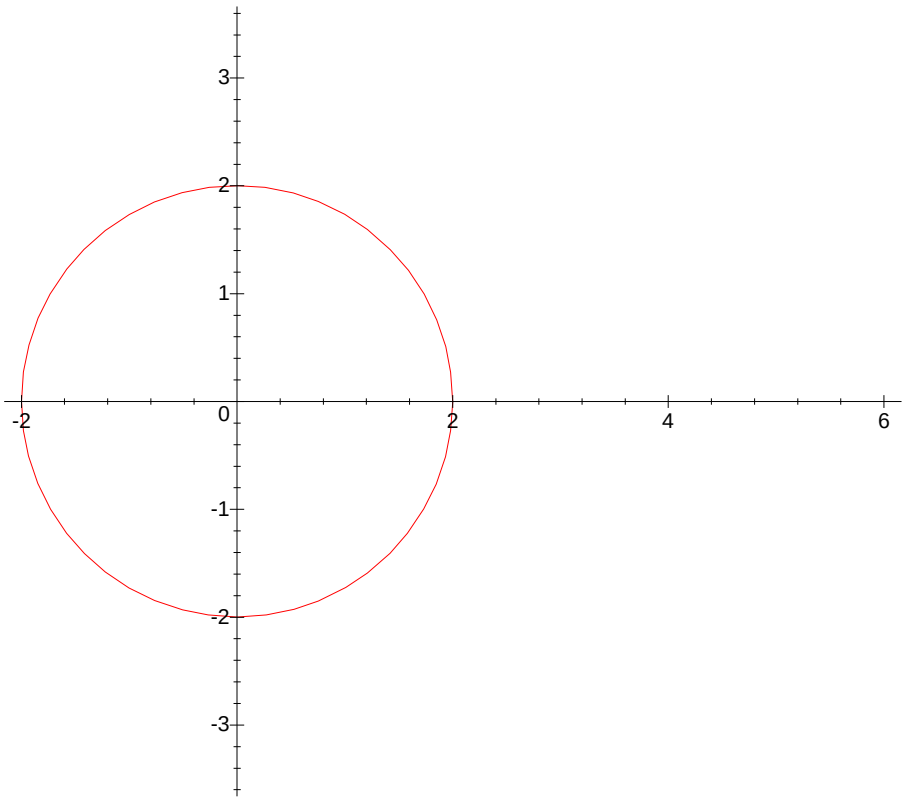



```
> C2 := [seq( polarplot( 2+‘i‘*sin(theta) ), ‘i‘={0,3/2,2,7/2}
  )]:
> display( C2 );
```

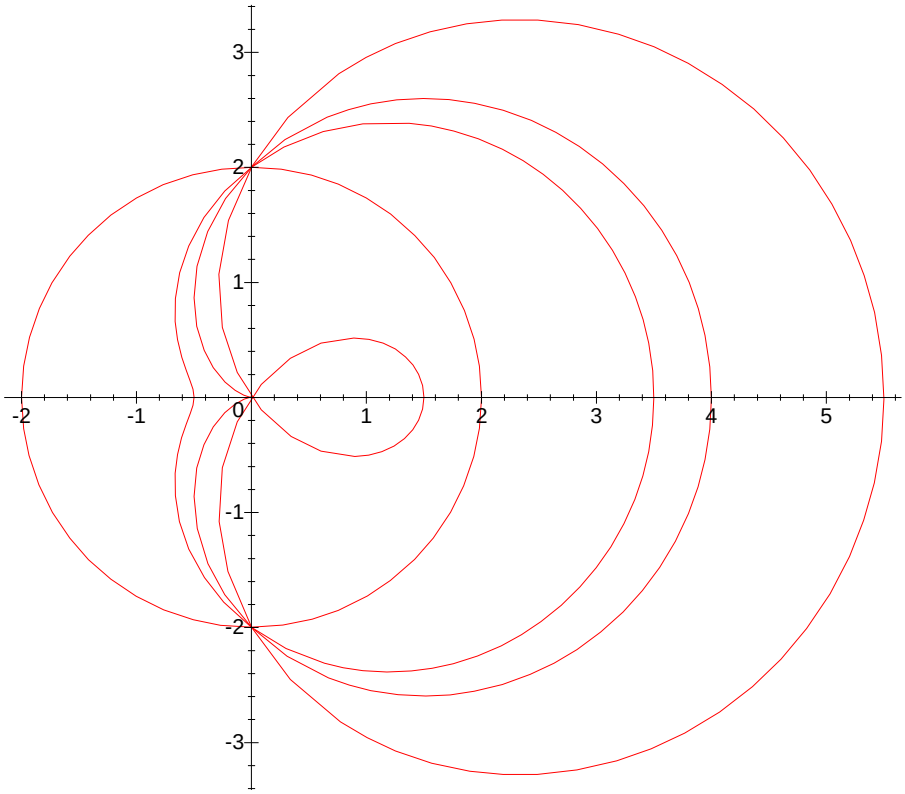



Next, we examine the difference between the two forms (i.e. replace sin with cos)

```
> C3 := [seq( polarplot( 2+‘i‘*cos(theta) ), ‘i‘=0..4 )]:
> display( C3, insequence=true );
```




```
> C4 := [seq( polarplot( 2+‘i‘*cos(theta) ), ‘i‘={0,3/2,2,7/2}
  )]:
> display( C4 );
```



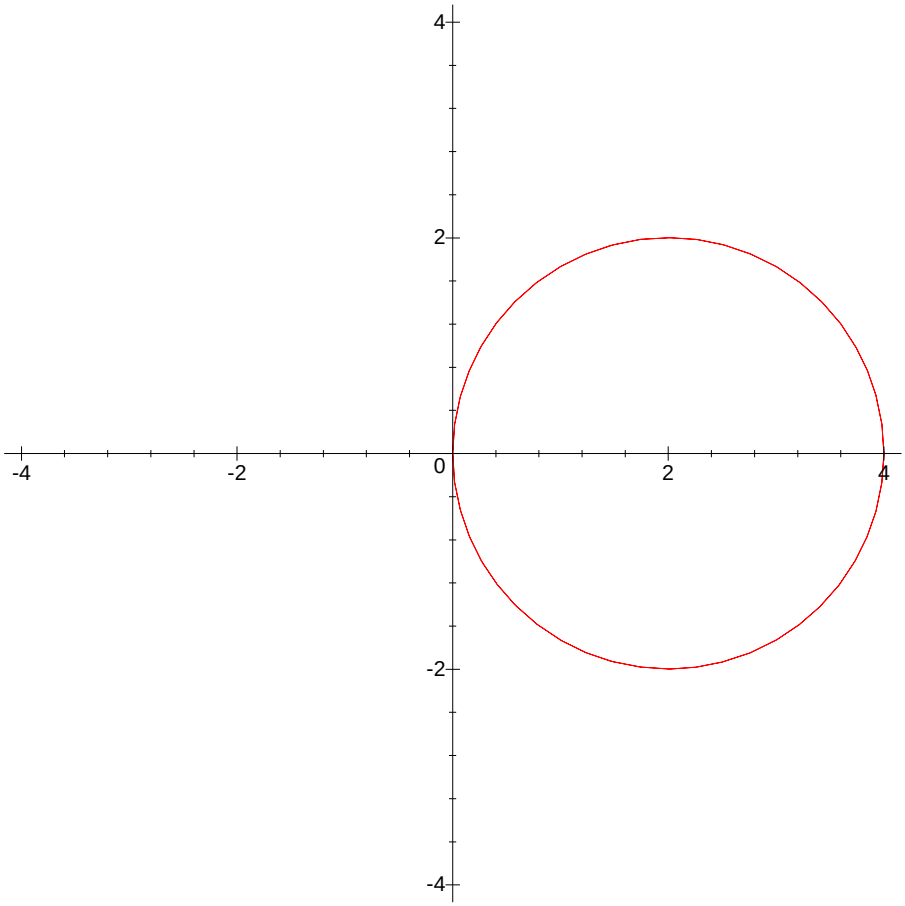

In general:
|a| >= |b| cardioid
|a| < |b| limacon

## *ROSES*

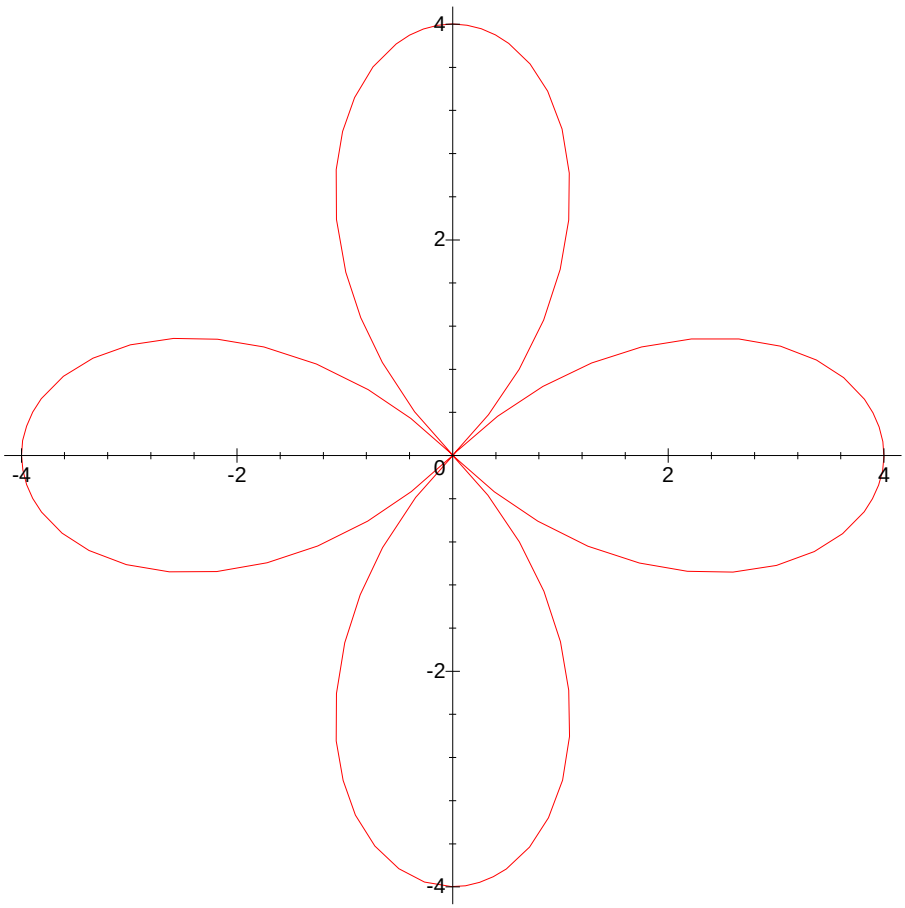
General form: r = a*cos(n*theta) and r = a*sin(theta)

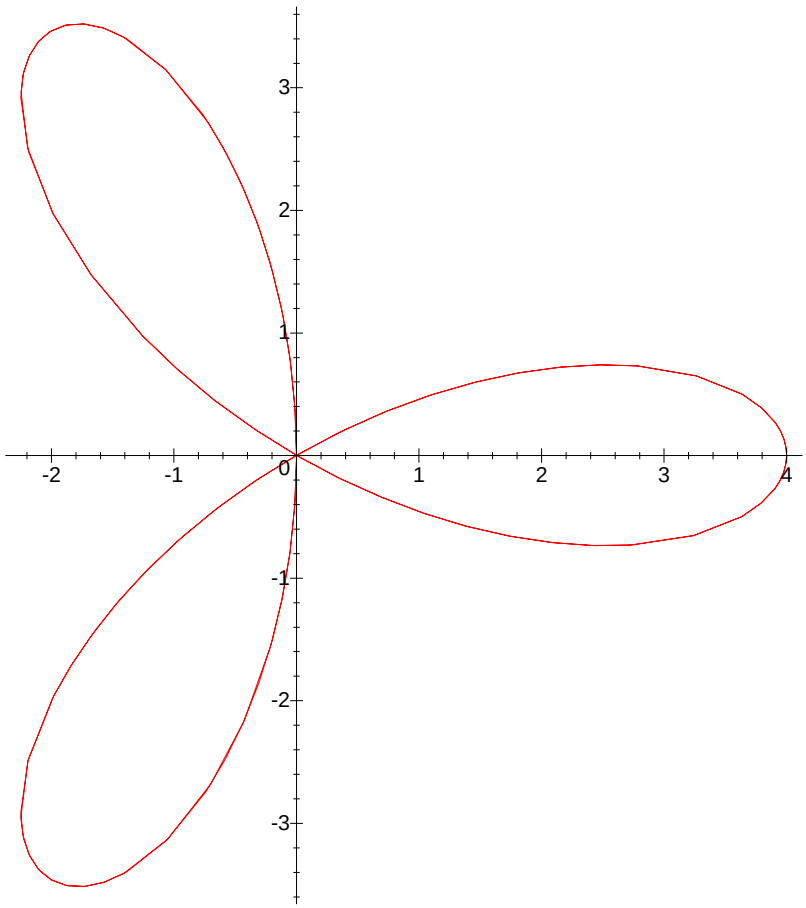
The integer n determines the number of leaves on the rose. Let's look for a pattern.

```
> R1 := [seq( polarplot( 4*cos('n'*theta) ), 'n'=1..8 )]:
> display( R1, insequence=true );
```



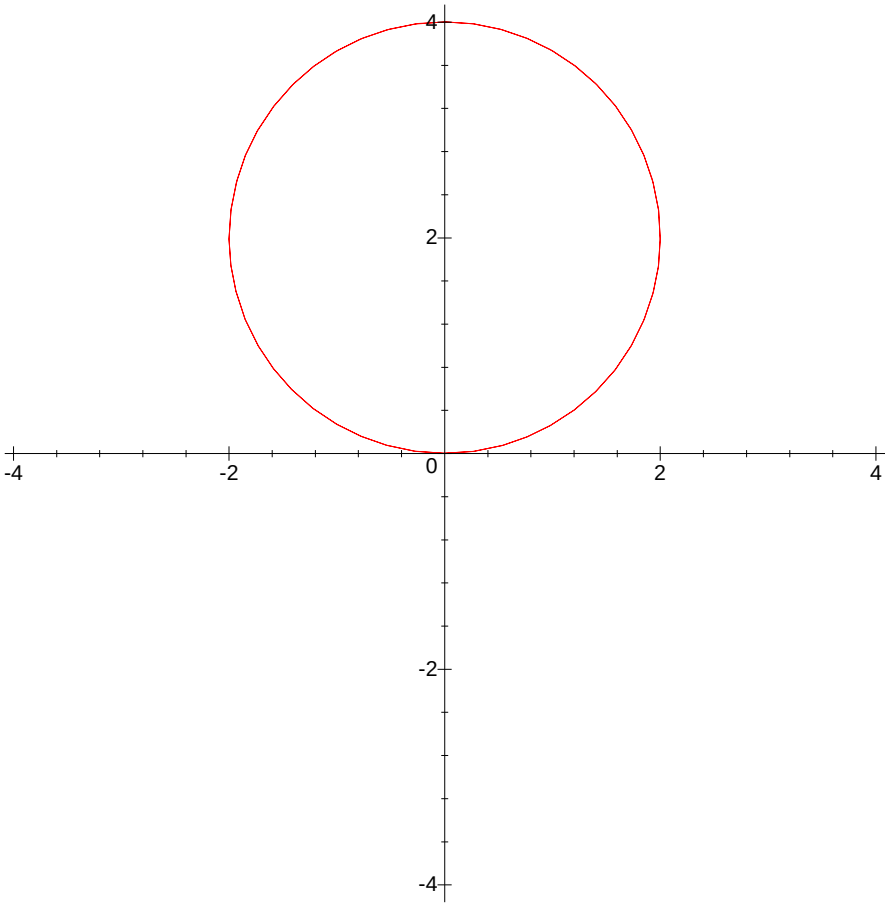

```
> polarplot( 4*cos(2*theta) );
> polarplot( 4*cos(3*theta) );
```


4
2
-4
-2
0
2
4
-2
-4

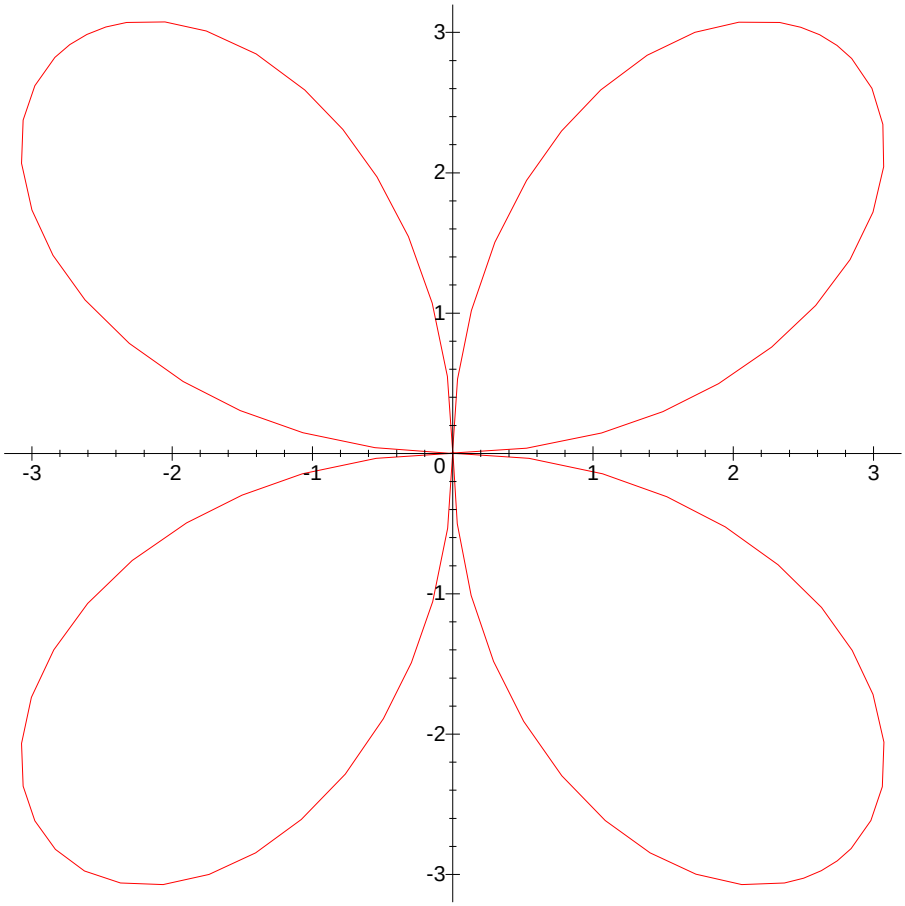



Finally, let's see what happens when cos is replaced with sin

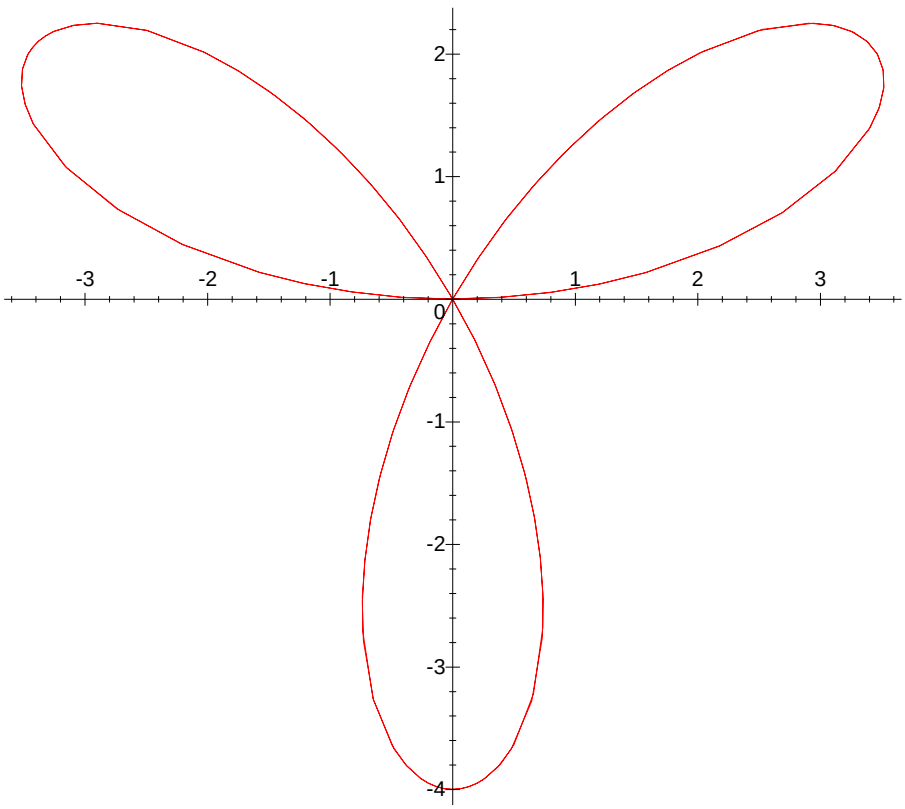
```
> R2 := [seq( polarplot( 4*sin('n'*theta) ), 'n'=1..8 )]:
> display( R2, insequence=true );
```




```
> polarplot( 4*sin(2*theta) );
```




```
> polarplot( 4*sin(3*theta) );
```


2
1
-3
-2
-1
1
2
3
0
-1
-2
-3
-4